Appl. No. 09/750,071
Amdt. dated July 6, 2004
Reply to Office action of April 7, 2004

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (currently amended) A method of controlling a space switch ~~to establish time-varying connections~~ having a plurality of input ports and a plurality of output ports, said method comprising:

receiving a stream of burst transfer requests ~~from a source node~~, each of said burst transfer requests ~~including parameters specifying a requested connection and a duration for said requested connection~~ specifying one of said input ports, one of said output ports, and a corresponding burst duration;

grouping said burst transfer requests into burst groups according to their corresponding input ports;

generating ~~scheduling information for each of said burst transfer requests based on said parameters~~ schedules for said burst transfer requests in an order in which input ports corresponding to said burst transfer requests become unoccupied;

transmitting said ~~scheduling information~~ schedules to sources of said ~~source node~~ burst-transfer requests; and

transmitting ~~instructions~~ said schedules and corresponding burst-transfer requests to a slave controller for said space switch, ~~where said instructions are based on said scheduling information and instruct said space switch to establish said requested connection~~ to set up paths through said space switch.

2. (canceled)

3. (currently amended) A space switch master controller comprising:

a source interface for:

receiving a stream of burst transfer requests from a source node, each of said

burst transfer ~~request~~ requests including parameters specifying a requested

connection and a duration for said requested connection;

transmitting scheduling information for each of said burst transfer requests to

said source node;

a burst scheduler for generating, in an order in which input ports corresponding to said

burst transfer requests become unoccupied, said scheduling information for each of

said burst transfer requests in said stream based on said parameters; and

a slave controller interface for transmitting instructions to a slave controller for said

space switch, where said instructions are based on said scheduling information and

~~instruct~~ cause said space switch to establish said requested connection.

4. (currently amended) A computer readable medium containing computer-executable

instructions which, when performed by a processor in a space switch master controller, cause

the processor to:

receive a stream of burst transfer requests from a source node, each of said burst

transfer requests including parameters specifying a requested connection and a

duration for said requested connection;   \

generate, in an order in which input ports corresponding to said burst transfer requests

become unoccupied, scheduling information for each of said burst transfer requests

based on said parameters;

transmit said scheduling information to said source node; and

transmit said scheduling information ~~instructions~~ to a slave controller ~~for~~ of said space

switch, ~~where said instructions are based on said scheduling information and instruct~~

~~said space switch to establish said requested connection.~~

5. (currently amended) A method of ~~generating~~ scheduling ~~information~~ comprising:

determining a next-available input port among a plurality of input ports and [[a]] an
input time index at which said next-available input port will become available;

for each burst transfer request of a plurality of burst transfer requests received ~~in
relation to~~ from said next-available input port, ~~and~~ where ~~each~~ said each burst transfer
request includes ~~an identity~~ a duration of a burst and a destination ~~for~~ of said burst:

determining, from said destination ~~for~~ of said burst, a corresponding output
port among a plurality of output ports;

determining a time gap, where said time gap ~~is a difference between:~~

~~said time index at which said next-available input port will become
available; and~~

equals a time index at which said corresponding output port will
become available minus said input time index;

selecting ~~one of~~ a particular burst transfer request from said plurality of burst transfer
requests ~~as a selected burst transfer request, where said selected~~ where said particular
burst transfer request has a minimum time gap ~~of said plurality of burst transfer
requests;~~ and

~~selecting~~ determining a scheduled time index, where said scheduled time index ~~is one
of said time index at which said next-available input port is available and~~ equals said
time index at which said corresponding output port is available if said time gap is
positive, otherwise said scheduled time index equals said input time index

~~; and~~

~~transmitting scheduling information for a burst identified by said selected burst
transfer request, said scheduling information based on said scheduled time index.~~

6. (currently amended) ~~The~~ A method of ~~claim 5~~ generating scheduling information
comprising:

~~wherein said~~ determining ~~said~~ a next-available input port among a plurality of input ports and a time index at which said next-available input port will become available ~~comprises~~ by scanning a time calendar until an input port identifier is detected in a time slot, said calendar having a plurality of time slots, where each time slot corresponds to a predefined time interval;

for each burst transfer request of a plurality of burst transfer requests received in relation to said next-available input port, and where said each burst transfer request includes an identity of a burst and a destination for said burst:

determining, from said destination for said burst, a corresponding output port among a plurality of output ports;

determining a time gap, where said time gap is a difference between:

said time index at which said next-available input port will become available; and

a time index at which said corresponding output port will become available;

selecting one of said plurality of burst transfer requests as a selected burst transfer request, where said selected burst transfer request has a minimum time gap of said plurality of burst transfer requests;

selecting a scheduled time index, where said scheduled time index is one of said time index at which said next-available input port is available and said time index at which said corresponding output port is available; and

transmitting scheduling information for a burst identified by said selected burst transfer request, said scheduling information based on said scheduled time index.

7. (original) The method of claim 6 wherein said determining said time gap comprises reading said time index at which said corresponding output port is available from an element in an array, where said element is associated with said corresponding output port.

8. (original) The method of claim 7 further comprising:

> determining, from said selected burst transfer request, a transfer-time for said burst;

> adding said transfer-time to said scheduled time index to result in a finishing time index; and

> writing said input port identifier in a time slot corresponding to said finishing time index.

9. (original) The method of claim 8 further comprising writing a null identifier in a time slot corresponding to said scheduled time index.

10. (original) The method of claim 9 further comprising writing said finishing time index to said element in said array.

11. (original) The method of claim 10 wherein said array is one of a plurality of arrays and said writing said finishing time index comprises writing said finishing time index to the element that is associated with said corresponding output port in each of said plurality of arrays.

12. (original) The method of claim 11 wherein said writing in each of said plurality of arrays is performed in parallel.

13. (original) The method of claim 10 wherein said time index at which said corresponding output port is available is selected as said scheduled time index.

14. (original) The method of claim 10 wherein a calendar time slot index at which said input port identifier is detected is selected as said scheduled time index.

15. (original) The method of claim 6 wherein said input port identifier is detected only if included in a predetermined group of input port identifiers.

16. (original) The method of claim 15 wherein burst transfer requests are organized by groups of output ports and said determining said time gap is limited to include only those burst transfer requests corresponding to a group of said plurality of output ports.

17. (currently amended) A burst scheduler comprising a processor operable to:

determine a next-available input port among a plurality of input ports and [[a]] an input time index at which said next-available input port will become becomes available;

for each burst transfer request of a plurality of burst transfer requests received in relation to from said next-available input port, and where each said each burst transfer request includes an identity a duration of a burst and a destination for of said burst:

determine, from said destination for of said burst, a corresponding output port among a plurality of output ports;

determine a time gap, where said time gap equals is a difference between:

said time index at which said next-available input port will become available; and

a time index at which said corresponding output port will become becomes available minus said input time index;

select a particular one of said plurality of burst transfer requests as a selected burst transfer request, where said selected burst transfer request where said particular one of said plurality of burst transfer requests has a minimum time gap of said plurality of burst transfer requests; and

select determine a scheduled time index, where said scheduled time index is one of said time index at which said next available input port is available equals said input time index when said time gap is negative and equals said time index at which said corresponding output port is available when said time gap is not negative; and

generate scheduling information for a burst identified by said selected burst transfer request, said scheduling information based on said scheduled time index.

18. (currently amended) A computer readable medium containing computer-executable instructions which, when performed by a processor in a burst scheduler, cause the processor

to:

determine a next-available input port among a plurality of input ports and [[a]] an input time index at which said next-available input port will become available;

for each burst transfer request of a plurality of burst transfer requests received in relation to from said next-available input port, and where each said each burst transfer request includes an identity a duration of a burst and a destination for of said burst:

determine, from said destination for of said burst, a corresponding output port among a plurality of output ports;

determine a time gap, where said time gap equals is a difference between:

said time index at which said next-available input port will become available; and

a time index at which said corresponding output port will become available minus said input time index;

select a particular one of said plurality of burst transfer requests as a selected burst transfer request, where said selected particular one of said burst transfer request requests has a minimum time gap of said plurality of burst transfer requests; and

select determine a scheduled time index, where said scheduled time index is one of said time index at which said next-available input port is available and equals said time index at which said corresponding output port is available, if said time gap is positive, and equals said input time index if said time gap is not positive; and

generate scheduling information for a burst identified by said selected burst transfer request, said scheduling information based on said scheduled time index.

19. (canceled)

20. (canceled)

21. (currently amended) A data network comprising:

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a plurality of edge nodes;

a plurality of core nodes, each core node of said plurality of core nodes including a space switch; and

a master controller for one said space switch in one said core node for:

receiving a stream of burst transfer requests from one of said plurality of edge nodes, each of said burst transfer requests including parameters specifying a requested connection and a duration for said requested connection;

generating, in an order in which input ports corresponding to said burst transfer requests become unoccupied, scheduling information for each of said burst transfer requests based on said parameters;

transmitting said scheduling information to said one of said plurality of edge nodes; and

transmitting said scheduling information instructions to a slave controller for of said one said space switch, where said instructions are based on said scheduling information.

22. (new) The method of claim 1 wherein said generating comprises:

determining a next-available input port to be considered;

determining a next burst group corresponding to said next-available input port;

if said next burst group includes at least two burst-transfer requests:

determining a time gap as an availability time of an output port specified in each of said at least two burst transfer requests minus an availability time of said next-available input port;

selecting a particular burst transfer request, from said at least two burst transfer requests, which corresponds to a lowest time gap;

if said next burst group includes one burst-transfer request:

    identifying said one burst transfer request as a particular burst transfer request;
and

    determining a starting time at which said space switch establishes a connection from said next-available input port to a particular output port specified in said particular burst-transfer request.

23. (new) The method of claim 22 further comprising:

    determining an updated availability time to equal said starting time plus a burst-duration time specified in said particular burst-transfer request;

    updating said availability time of said next-available input port to equal said updated availability time; and

    updating an availability time of said particular output port to equal said updated availability time.

24. (new) The method of claim 22 wherein, if said next burst group has no burst-transfer requests, updating said availability time of said next-available input port by adding a burst-duration of an artificial burst.

25. (new) A master controller of a space switch, said space switch having a plurality of input ports and a plurality of output ports, said master controller operable to:

    receive a stream of burst transfer requests, each of said burst transfer requests specifying one of said input ports, one of said output ports, and a corresponding burst duration;

    group said burst transfer requests into burst groups, each of said burst groups corresponding to one of said input ports;

    generate schedules for said burst transfer requests in an order in which input ports corresponding to said burst transfer requests become unoccupied;

transmit said schedules to sources of said burst-transfer requests; and

transmit said schedules and corresponding burst-transfer requests to a slave controller of said space switch to set up paths through said space switch.

26. (new) A core node in a burst-switching network, said core node comprising:

at least one space switch having a plurality of input ports and a plurality of output ports; and

a master controller operable to:

exchange time-locking signals with each of a plurality of edge nodes;

receive, from at least one edge node of said plurality of edge nodes, a stream of burst transfer requests for bursts of arbitrary sizes;

determine a burst-transfer time for each of said bursts; and

communicate an indication of said burst-transfer time to said at least one edge node from which said stream of burst-transfer request originated.

27. (new) The core node of claim 26 comprising at least two space switches and said master controller is further operable to select one of said at least two space switches for switching said each of said bursts.

28. (new) A burst-switching network comprising:

a plurality of core nodes, each of said plurality of core nodes including a bufferless space switch; and

a plurality of edge nodes, each of said plurality of edge nodes having:

a communication link to each of at least one of said plurality of core nodes; and

a data buffer associated with said communications link;

where each of said plurality of edge nodes is adapted to perform a process for time-locking to each of said at least one of said core nodes; and

wherein said each of said plurality of edge nodes is adapted to:

send a stream of burst-transfer requests to a selected core node of said at least one of said core nodes, where each burst-transfer request of said stream of burst-transfer requests corresponds to a burst having a duration below a specified limit;

receive a stream of burst-transfer schedules from said selected core node; and

transmit bursts corresponding to said burst-transfer requests to said selected core node according to said burst-transfer schedules.

29. (new) The burst-switching network of claim 28 wherein said burst-transfer schedules are based on a calendar having a predefined calendar period, where said calendar has been divided into a predefined number of divisions.

30. (new) The burst-switching network of claim 29 wherein each of said core nodes includes a master time counter having a predefined counter period and each of said edge nodes includes a slave time counter having said predefined counter period, and said process of time locking uses said slave time counter and said master time counter.

31. (new) The burst-switching network of claim 30 wherein said counter period exceeds a round-trip propagation delay between any of said edge nodes and any of said core nodes.

32. (new) The burst-switching network of claim 30 wherein said counter period is an integer multiple of said calendar period.

33. (new) The burst-switching network of claim 32 wherein said integer multiple equals a first power of two, and said predefined number of divisions equals a second power of two.

34. (new) The burst-switching network of claim 29 wherein said calendar period is selected to at least equal said specified limit.